

POD SHELLING MACHINES - A REVIEW

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ABSTRACT

The shelling of pods is very difficult and time consuming operation. It effects very much on the processing of grains. In past shelling is done by manually and by the help of animals. But now a day's different pod shelling machines are available in the industry. This study has been carried out to know the different pod shelling machines available. Also the different type of materials of machines were used by the different researchers. In this study also the different techniques of shelling used in the different machines is discussed.

KEYWORDS: Pods, Shelling, Shearing & Impact

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INTRODUCTION

Design of Rubber Roll Sheller

Ezaki (1973) observed that in case of husking by rubber roll (paddy) deformation caused by shear and compression of the two rotating rubber surfaces is sufficient to split and separate the husk from the grains. The paddy is passed through the clearance between two rubber rolls, rotating in opposite directions at different speed. The clearance between them is smaller than mean thickness of paddy. One part of husk is subjected to shearing force whereas the other part in contact with slower roll is under compression and is thus subjected to breaking force.

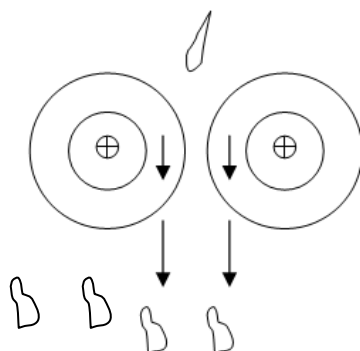


Figure 1: Principle of Operation of Rubber Roll Husker

Zyulin (1979) performed an experiment on separation of grain on sieves according to the sifting rate and stated that shorter particles pass more readily through a sieve of given mesh than longer ones of the same width. On a sieve of 2.29 mm mesh, it was found that the average size of particles dropping through was 2.00 mm initially and 2.20 mm near the end. This partial separation can be attributed to the probability of a particle passing through the mesh. A theoretical study is made of the sifting process on a multiple set of sieves utilizing the differences in the ease (speed) with which particles drop through a sieve as a criterion for separation. The theory was verified in laboratory experiments in which short (chaff) and long admixtures (oats) were separated from wheat on sieves with a circular mesh of 6.5 and 9.0 mm at a feed rate of 18.5 t/h. **Wimberly (1983)** stated that in rubber roll paddy dehusker, the faster operating, unadjusted rubber roll wears out faster than adjusted roll. The rolls are interchangeable, and their location should be changed from time to time to ensure even wear. Uneven wear on a roll changes the peripheral speed and reduces hulling capacity. For optimum performance, the grain should be evenly distributed over the full width of rolls. Otherwise the roll surface wears out unevenly, reducing efficiency and capacity. Unevenly worn out rolls can be corrected by turning them on a lathe. Heating adversely affects the durability of rubber rollers. To prolong their life, the rollers are changed when they are too hot, they must be allowed to cool. Most of the rubber roll huskers incorporate an air cooling system where by air is drawn through the housing to reduce roll temperature. **Sharma and Mandhyan (1988)** developed a hand operated pea shelling machine. They tried three different surfaces (i) punched tin sheet, (ii) cycle tyre treads and (iii) gunny bag cutting. **Sharma and Singh (1989)** reported that the size and bulk density decreased with increase in moisture content, angle of repose increase with moisture content and the shelling efficiency improved with decrease in moisture content. The best result was achieved at 73.6 per cent moisture content (wb) of green pea pods having about 100 per cent kernel recovery and 4 per cent damaged kernels. **Ademosun (1990)** designed a medium-scale cocoa dehulling and winnowing machine. The performance evaluated that the machine is easy to operate with only the adjustment of roller clearance. The machine was found to have high dehulling and winnowing efficiencies at the optimum roller clearance. **Nalbant (1990)** studied and investigated that the of damage of corn kernel percentage caused by the concave and the cylinder after and before the shelling of kernels from the cob and the effects of kernel moisture content and cylinder velocity on kernel damage. It showed that kernel percentage increased with an increase in moisture content percentage of corn kernel and cylinder velocity. There was also effect of properties of corn ear, rate of feeding, types of cylinder and concave on the mechanical damage. **Gol and Nanda (1990)** studied the performance of a power-operated double drum groundnut pod stripper with vertical spikes for stripping groundnut. The machine consists of stripping cylinders, blowers and sieve as its major functional components for detaching and cleaning pods. The trials were conducted on ICGS 11 groundnut crop. It operated on maximum cylinder peripheral speed of 615 m/min (450 rpm) with blower speed 900 rpm (air velocity 2.6 m/sec) with average stripping capacity of 59 kg/h (At 14% m.c. and 40% pod ratio). **Gore et al. (1990)** showed that as shelling speed increased breakage increased for the same clearance, feed rate and moisture content. **Singh (1990)** modified a simple rocking type groundnut decorticator to facilitate fabrication and adjustment of gap between its crushing shoes and concave grate. This was achieved by eliminating the slots provided on each individual crushing shoes and by fixing them directly to the lower segment of the rocking arm. The gap was adjusted by increasing or decreasing the length of the lower segment of the rocking arm through the pivot axle which enabled gap adjustment in all the three shoes uniform simultaneously. The capacity of the decorticator was 70-80 kg/h with breakage 3.7% - 6.5%. **Singh (1983)** modified two peanut shellers, one manual and other hand power operated to improve their performance. The modified manual peanut sheller has a mechanism to adjust the clearance, and round tooth shelling bars, with a capacity of 32 kg (seed)/h with about 4.8% breakage and 96% shelling efficiency. The modified power operated peanut sheller has, a feeding mechanism and a blower

with a capacity of 175 kg (seed)/h at 145 stroke/min shelling bar speed and 2 cm clearance has shelling efficiency of 97% with 4.7% breakage, 0.2% blower loss, 98.3% cleaning efficiency with 2.2 kW power consumption. **Wierzbickiet al (1991)** examined the effects of rotational horizontal motion and oscillatory vertical motion on the quality and efficiency of wheat grain cleaning with variable grain mixture throughput. and studied on a test rig which allowed additional independent circular motion of the sieve basket in the horizontal plane. Both vertical and horizontal motion and throughput had a significant effect on grain cleanness and losses. **Adigun and Oje (1993)** reported that nuts whose shells/pods cannot be easily broken by the roller cracker are commonly cracked using a centrifugal cracker.

Ajav and Igbeka (1995) carried out performance tests on a Nigerian maize sheller using an International Standard test code (IS: 7052-1973). The tests were intended to study the general qualities and design of the sheller. The results show that the shelling efficiency of the sheller varies with moisture content, speed of the shelling unit and the feed rate. The machine has a shelling efficiency of 98%, 95% and 94% when shelling corn with a moisture content of 11%, 20% and 25% respectively. The sheller has a cleaning efficiency of 93%, 87% and 85% when shelling corn with a moisture content of 11%, 20% and 25% respectively, with a shelling unit speed of 400 rpm and fan unit speed of 750 rpm. The sheller has a capacity of 260 kg/h. The performance tests proved that the sheller performs best at a shelling unit speed of 450 rpm. with minimum losses and high efficiency. **Glancey et al (1995)** modified a pea shelling machine in which operation begins by loading whole plants onto the feed conveyor. They found that the green pea loss was greatest at the highest beater speed. The optimal beater speed for threshing green pea varieties was in the range of 175 to 200 rev/min. This range corresponded to a beater tip velocity range of 8.9m/s. **Singh (2000)** carried out investigations to know the effect of moisture content and pod size on shelling efficiency of the power operated green pea pod shelling machine developed at Jabalpur centre of PHTS. Moisture levels of 68.5 to 75.7 % (wb) and 20.8-24.5 mm pod size was found most suitable for each variety of green pea pods. Shelling efficiency of Arkel variety was found best at all the levels of moisture content and pod size. Shelling efficiency decreased with increase in moisture content and decrease in size of pods in all varieties of pea under study. **Helmy et al (2001)** fabricated a reciprocating peanut sheller as a multi-crop sheller to shell peanut, soybean, bean, etc. and also some modifications were done. After modification it showed better performance, having values of shelling efficiency of 98.85 %, damaged seeds of 1.36%, unshelled seeds of 1.15%, total losses of 2.51%. **Singh (2003)** developed a power operated green pea shelling machine for Arkel and JM-1 cultivars of green pea pods. For both green pea pods varieties the best suitable level of moisture ranges between 60 to 65% (db) and size of pods were ranges between 23 to 25mm. The maximum shelling efficiency was found in in the 'Arkel' variety at moisture content of 98.94% (db) followed by 'JM-1' with moisture content of 65.14% (db). It was noted that the shelling efficiency is inversely proportional to moisture content upto 65% and then after shelling efficiency varied directly with the moisture. **Oluwale et al (2004)** designed, constructed and tested a sheanut cracker and evaluated its performance. The cracker having controller of flow rate device on which hopper is fitted, power system, unit of winnowing, works on the impact principle which is using centrifugal force from a spinning disc. At the moisture content and feed rate of 22.7 % (db) and 11.4kg/h respectively the performance of cracker was highest. **Butts et al (2009)** did modification in the two row peanut combine which was formerly used for peanuts which was withdrawn with a view to shell the peanuts with the harvesting. It was shown that 91% of the captured peanut kernels were threshed successfully and 99% of the kernels are harvested successfully. Modified peanut combine reduces the amount of foreign material as compared to peanut harvester from 30 to 16 %. **Ghafari (2011)** designed and constructed a walnut cracker and tested it to evaluate its performance. It consists of a feeding hopper having arrangement for flow control, a unit of cracking, a sorter and the power system. It operates on the principle of force of

crushing caused by the helix and cylinder. 66.66 % of whole kernels were produced and the estimated capacity of machine to be about 25.2kg/h. **Rajput et al (2008)** developed a green chickpea pod stripping cum shelling machine mainly consists of three units which are stripping, shelling and cleaning unit. The shelling unit was modified by the addition of a third roller having same dimensions as the upper two rollers and also by covering the upper two rollers by the corrugated metal sheet having holes of diameter 0.5 mm with 0.5 mm edges. It has 8 holes in horizontal direction and 5 holes in vertical direction per inch. This corrugated metal sheet was pasted on the upper two rollers in such a way that no gap is found between the holes of the sheet. All the holes were made at uniform distance on the surface of the roller for better shelling action. The third rubber roller was operated at the medium speed and by this third roller the double shelling action was done on the pods. Hence the shelling occurred in two stages with better results as compared to earlier shelling with the rolls. **Singh et al (2012)** designed, developed, fabricated and evaluated a hand operated maize dehusker-sheller. The developed machine can be easily operated with right or left hand of the farm women. The output capacity and the feed rate was found to be 60 and 80 kg/h respectively. At the 5.6 m/s peripheral speed of cylinder the efficiency of dehusking, shelling and breakage of grain observes was 100%, 98.8% and 0.3% respectively. There was requirements of two farm women, for feeding and cracking for the operation of the machine. **Soha et al (2012)** developed a machine for pea shelling. The machine performance was studied as a function of change in drum speed, feed rate and grain moisture content for two green pea varieties (Little Marvel and Master B). Performance evaluation of the developed machine was carried out in terms of machine productivity, shelling efficiency, crop losses, cleaning efficiency, energy requirements and criterion cost. The experimental results revealed that crop losses as well as criterion cost were minimum while shelling and cleaning efficiencies were maximum under the following conditions. The use of the developed machine for green pea shelling, operate the developed machine at a drum speed of between 620 to 710 rpm (8.26 to 10.26 m/s), carry out the shelling operation at a grain moisture content of between 66.4 to 69.8% and operate the developed machine at a feed rate of between 300 to 360 kg/h. **Singh and Mangaraj (2013)** developed and evaluated a refined design of centrifugal sheller for muskmelon seed decortications. At the speed of 1400rpm of emery roll the capacity of 5kg/h was observed by the developed machine. The seed damage and efficiency of shelling was respectively 32%, 51%. There was very low cost of decortication found in the case of developed machine, which was Rs. 1.20/kg as compared to manual decortication methods which was Rs. 100/kg. **Rajput et al (2013)** developed a Green Chickpea pod stripping cum shelling machine at AICRP on Post Harvest Technology, College of Agricultural Engineering, Jabalpur. This machine mainly consists of three units viz. stripping, shelling, and cleaning unit. The capacity, stripping and shelling efficiency was observed to be 24 kg/h, 93.66 % and 89.44 per cent, respectively. **Sharma et al (2013)** studied and evaluated the performance parameters of centrifugal impaction type decorticator for tung fruits. The performance indicators include the whole seed percentage, broken seed percentage, fruit shelled partially, unshelled fruit, efficiency of machine and efficiency of decortication. were evaluated at three different moisture contents (8.65%, 12.13% and 15.61% d.b.) and at different speeds of rotating blades (1600, 1800 and 2000 rpm). For optimum force, the clearance of 100mm was fixed between the striking plate and the rotating blade. At the moisture content of 8.65%(db) and having the speed of blade of 1800 rpm the best results obtained of recovery of 52.24% whole seeds and the efficiency of machine of 74.63% were obtained.

CONCLUSIONS

The performance evaluated that the machine is easy to operate with only the adjustment of roller clearance. The machine was found to have high dehulling and winnowing efficiencies at the optimum roller clearance. The output and shelling efficiency of power operated castor bean sheller are 163.00 and 52.65 kg and hand operated castor bean sheller are

97.29% and 98.72% with a kernel breakage of 0.82% and 0.88%, respectively. The capacity of the decorticator was 70-80 kg/h with breakage 3.7% - 6.5%. The modified power operated peanut sheller has, a feeding mechanism and a blower with a capacity of 175 kg (seed)/h at 145 stroke/min shelling bar speed and 2 cm clearance has shelling efficiency of 97% with 4.7% breakage, 0.2% blower loss, 98.3% cleaning efficiency with 2.2 kW power consumption. The sheller has a cleaning efficiency of 93%, 87% and 85% when shelling corn with a moisture content of 11%, 20% and 25% respectively, with a shelling unit speed of 400 rpm and fan unit speed of 750 rpm. The sheller has a capacity of 260 kg/h.

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